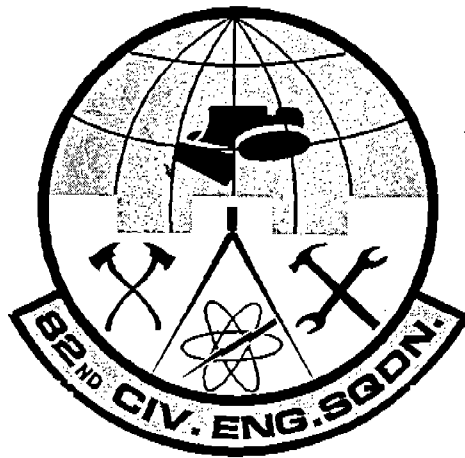


**STATEMENT OF WORK
FOR
IDIQ MECHANICAL UTILITY
SYSTEMS**

PROJECT VNVP 971100



June 1997

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SECTION 01000

STATEMENT OF WORK

1. DESCRIPTION OF WORK:

1.1 Work to be done: The work to be performed under this contract and in accordance with these contract documents shall consist of furnishing all necessary plant, labor and materials; and constructing, installing and performing all work shown and described in the contract documents, all of which are made a part thereof. The government has the right to exercise options to extend the basic 12 month term of this contract by four separate 12 month periods in accordance with FAR 52.217-9 Option to Extend the Term of the Contract Services (APR 1984).

1.2 Character of Work and Mechanics: The work shall be executed in the best and most workmanlike manner by qualified, careful, and efficient mechanics skilled in the trade. The work shall be in strict accordance with the contract documents and standards of the industry.

1.3 Location: Sheppard Air Force Base is located in Wichita County, approximately five miles north of Wichita Falls, Texas. The project is VNVP 971100 IDIQ Mechanical Utility Systems

2. PRINCIPAL FEATURES:

2.1 All work shall be in conformance with the drawings and specifications including the furnishing of all materials, labor, plant, tools, equipment, and services necessary and incidental thereto. The work required to be performed by the contractor consists of, but limited to, the following principal items:

2.2 Replace water, sanitary sewer, gas distribution, and underground sprinkler systems, laterals and service lines including all valves, fittings, appurtenances and related items within basewide and Military Family Housing (MFH) areas of Sheppard AFB; in accordance with the plans and specifications as required by each task order.

2.3 All material labor, equipment, and other associated cost necessary for the installation of the water, gas, sanitary sewer mains, underground sprinkler systems, laterals and service lines shall be considered subsidiary to the price per foot of the pipe.

2.4 The unit price for the installation of the water, gas, sanitary sewer, underground sprinkler systems, laterals and service lines shall have incorporated into the price per foot, depths of at least ten feet, soil testing and trench protection. Depths exceeding ten feet and the required trench protection are taken into consideration in the item for depths greater than 10 feet.

3. WORK HOURS, UTILITY OUTAGE, AND SPECIAL CONDITIONS:

3.1 WORK HOURS: Work hours shall be 7:30 a.m. to 4:30 p.m., Monday through Friday, exclusive of Federal holidays. At the option of the government and with approval of the Contracting Officer, work may be permitted on Federal holidays, weekends or after 4:30 p.m. daily at no additional cost to the government. The contractor shall provide written notice to the Contracting Officer at least 48 hours before starting the scheduled work.

3.2 UTILITY OUTAGE: When an extended utility outage is necessary to perform the contract work in an occupied facility, regardless of whether or not the work area itself is occupied, the outage shall be performed by the contractor during non-duty hours at no additional cost to the government, unless otherwise approved by the Contracting Officer. The contractor shall give written notice two weeks in advance of scheduled outage.

3.3 SPECIAL INSTRUCTIONS:

3.3.1 Separate Contracts: The Government reserves the right to award separate contracts for work identical to work covered by this contract, or to perform such work using in-house forces. Such work will proceed in such a manner and sequence that work under this contract can proceed with a minimum of interference and inconvenience to the Government and the contractor. However, the contractor will be required to provide the maximum degree of cooperation with other contractors engaged in other Government contracts at no additional cost to the Government.

3.3.2 Task Orders: Performance of services shall be accomplished by the contractor by task orders issued, by the Contracting Officer, against the indefinite delivery/indefinite quantity contract, prior to the beginning of specified performance periods during the performance of this contract. The contractor shall be required to perform the services as specified herein. Invoices in four copies shall be submitted when a task order is completed or monthly whichever comes first. Invoices shall contain the following:

- a. Name of contractor
- b. Contract Number
- c. Date of Order
- d. Itemized List of Services Performed
- e. Quantity, Unit Price, and Extension for each unit
- f. Date of Performance
- g. Task order Number

3.3.3 Allotted Performance Time:

PERFORMANCE TIME CHART UNDERGROUND UTILITY WORK

<u>DOLLAR</u> <u>AMOUNT</u>	<u>CALENDAR</u> <u>DAYS</u>	<u>DOLLAR</u> <u>AMOUNT</u>	<u>CALENDAR</u> <u>DAYS</u>	<u>DOLLAR</u> <u>AMOUNT</u>	<u>CALENDAR</u> <u>DAYS</u>
50,000	61	68,000	79	115,000	97
51,000	62	69,000	80	120,000	98
52,000	63	70,000	81	125,000	99
53,000	64	71,000	82	130,000	100
54,000	65	72,000	83	135,000	101
55,000	66	73,000	84	140,000	102
56,000	67	74,000	85	145,000	103
57,000	68	75,000	86	150,000	104
58,000	69	76,000	87	155,000	105
59,000	70	77,000	88	160,000	106
60,000	71	78,000	89	165,000	107
61,000	72	79,000	90	170,000	108
62,000	73	80,000	91	175,000	109
63,000	74	85,000	92	180,000	110
64,000	75	90,000	93	185,000	111
65,000	76	100,000	94	190,000	112
66,000	77	105,000	95	195,000	113
67,000	78	110,000	96	200,000	114
				205,000	115

Performance time for delivery orders in excess of \$205,000 will be extrapolated by adding one calendar day for each \$5,000 (or any part thereof). These performance times represent the minimum performance time the contractor will be allowed.

*If, as determined by the Government, it is in the best interest of the Government to negotiate a shorter performance time(s) than that allowed for any task order(s), as established in accordance with the provisions herein, the Government reserves the right to enter into negotiations with the contractor for that purpose.

3.3.3.1 When a task order is issued, it will specify a required start date and a required completion date computed in accordance with paragraph 3.3.3 above. Performance times on task orders are independent of each other and may run concurrently. Liquidated damages, at the specified rate, may be applied, at the discretion of the Contracting Officer, to individual task orders with no adjustment in the contract unit prices paid the contractor for services rendered.

3.3.4 Special Provisions For Measurements:

3.3.4.1 Quantity Takeoff: Within 5 days of being notified of a new project, the contractor shall be required to examine the drawings, visit the site or both, as appropriate, and submit to the Contracting Officer a proposal containing the unit priced bid items and their quantities necessary to complete the work as shown or as indicated. The contractor's proposed unit priced bid items and their associated quantities shall be determined using measurements taken from the provided drawings and, as necessary, using field measurements taken at the site. In the absence of drawings, the contractor will be provided a detailed description of the proposed work and must perform measurements in the field to determine the quantities of each unit proceed bid item necessary to complete the work as described. Measurements, whether taken from prepared drawings, from the field, or both, shall be made in strict accordance with the "Measurement" paragraphs contained herein. Formal site visits will be held when requested by either the contractor or the Government. Differences between the contractor's independently prepared proposal and the Government estimate will be resolved through negotiations with the Contracting Officer. Once agreement has been reached, a firm-fixed price task order containing the negotiated unit priced bid items, their quantities and the performance time will be issued to the contractor. No changes to the negotiated quantities will be made and no additional unit priced bid items will be added unless differing site conditions are encountered and the drawings and/or description of the work is modified by the Contracting Officer to accommodate the differing site condition(s) encountered. The contractor is responsible for notifying the Contracting Officer immediately upon encountering differing site conditions.

3.3.4.2 Performance Time: Performance time for each "task order" will be assigned by the Contracting Officer in accordance with "allotted performance time" paragraph above.

3.3.5 Inspection and Acceptance: Inspections and final acceptance will be made on each separate "task order" as completed by the contractor with the following additional provision:

3.3.5.1 The contractor shall make sure that the work is ready for all inspection. The presence of an unreasonable number of deficiencies, as determined by the Contracting Officer's representative, may cause the inspection to be rescheduled.

3.3.5.2 Upon successful completion of the final inspection, the contractor will be given a list of outstanding discrepancies, if any, which upon correction for any discrepancy listed, will serve as a notice of acceptance by the Contracting Officer's representative for each successfully completed "task order." The list will be signed by the Contracting Officer or his representative. One copy of the list will be given to the contractor. The contractor's invoice for final payment will not be honored until all listed discrepancies have been corrected.

3.3.6 Manning: The contractor is required to have, on hand or readily available, sufficient crews

to meet his obligation to provide delivery of the work under contract within the time)s_ allocated.

3.3.7 Deteriorated Construction and Finish: The Contracting Officer will be the governing authority in determining if existing construction and finishes are deteriorated and require repair and/or replacement. The contractor shall not perform any work under this contract without a receipt of a duly authorized "task order" from the Contracting Officer.

3.3.8 Occupied Areas: The work to be performed on this project will include work in occupied areas and the contractor shall phase his work to insure the work does not interfere with the work of other contractors or government work during the performance of any "task order." Contractor shall coordinate the work of all activities whereby both the government and the contractor can continue operations with the least possible interference and inconvenience. The contractor shall conduct all work such that means of ingress and egress from any area are maintained. The contractor shall be responsible for furnishing, installing, and maintaining suitable, approved barricades, roped barriers, etc., to warn occupants of hazardous areas at the jobsite for the duration of the contract at no additional cost to the Government.

4. BASE FIRE REGULATIONS:

4.1 The contractor shall comply with Base Fire Regulations in SAFBI 32-2001, 20 Sep 96. The contractor shall use no explosives or fire in performing the work. The contractor shall understand and comply with welding and cutting requirements in AFOSH Standard 91-5, dated 30 Apr 1995.

5. ENVIRONMENTAL REQUIREMENTS:

5.1 Compliance with Laws: The contractor shall comply, and assure that all subcontractors comply, with all applicable federal, state, and local laws, regulations, ordinances, policies and standards related to environmental matters. The contractor shall also comply, and assure that all subcontractors comply, with all specific instructions or directions given to the contractor by the government regarding environmental matters.

5.2 Hazardous Materials: The contractor shall provide the Base Hazardous Materials Management Office (HAZMO) Pharmacy, Bldg 21, (817) 676-1123 and Base Fire Department, Bldg 1093, (817) 676-2104 (82 CES/CEFS) a written list of all hazardous materials that the contractor will bring onto government property. The contractor shall further provide a Material Safety Data Sheet (MSDS) for each hazardous chemical listed in OSHA Hazard Communication Standard 29 CFR 1910.1200. In addition, the contractor shall observe storage practices in accordance with procedures provided by the Environmental Coordinator, Bioenvironmental Engineer, Wing Safety office and Base Fire Department for hazardous materials stored on base.

5.3 Hazardous and Special Wastes Generated by the Contractor: For all regulated wastes generated, removed or otherwise produced by work required by this project, the contractor shall identify, characterize, containerize, transport, store and dispose of hazardous wastes in strict

accordance with federal guidelines found in the Code of Federal Regulations, Title 40 (40 CFR) parts 260-270; state guidelines found in the Texas Administrative Code, Title 49 (49 CFR) parts 171-179, Title 30 TAC; Chapter 335, Texas Natural Resource Conservation Commission Industrial Solid and Municipal Hazardous Waste Regulations; all local guidelines; and as specified.

5.3.1 The contractor shall handle asbestos-containing waste in strict accordance with federal guidelines found in the Code of Federal Regulations, Title 40 (40 CFR) Part 61, Subpart M {As revised at 55 FR 48414-33, Nov. 1990, and corrected at 56 FR 1669, Jan. 16, 1991}. Friable asbestos waste shall be disposed of as a special waste.

5.4 Hazardous and Other Regulated Material Encountered by the Contractor: The contractor shall notify the Contracting Officer upon coming across any material, not identified in the contract documents, thought to be hazardous to workers or personnel in the area. The government shall be responsible for characterizing, transporting, storing and disposing of the waste if necessary.

5.4.1 Asbestos: To the best of the government's knowledge, no asbestos-containing material (ACM) will be disturbed by this project. Should the contractor encounter previously unidentified or suspected ACM which must be disturbed to comply with the contract documents, the contractor shall cease all work that would disturb the suspect material and shall immediately notify the Contracting Officer. The government will take steps, as appropriate, to ascertain the material's composition and determine any remedial actions necessary.

5.4.1.1 Any asbestos abatement shall conform to the most current federal regulations regarding asbestos abatement activities, 29 CFR 1926.1101 {Contains the revised OSHA Construction Standard as it appeared in the Federal Register dated August 10, 1994, but including corrections issued in the Federal Register of June 29, 1995 and September 29, 1995}.

5.4.1.2 The asbestos abatement contractor shall be responsible for coordinating the 10 working day Texas Department of Health (TDH) demolition/renovation notifications through the base asbestos coordinator, (817) 676-5720.

5.4.1.2.1 The asbestos abatement contractor shall be responsible for providing information relating to the abatement project(s) such as: abatement contractor information, their business address, TDH license number, demolition contractor, project contractor, waste transporter information, waste disposal site information, the start date of actual asbestos abatement work and the scheduled completion date.

5.4.1.2.2 The TDH 10 day notification information shall be provided to 82 CES/CEV a minimum of 15 working days in advance of the actual asbestos abatement.

5.5 Nuisance and Polluting Activity Prohibited: Polluting, dumping, or discharging of any harmful, nuisance, or regulated materials (such as concrete truck washout, vehicle maintenance fluids, residue from saw cutting operations, solid waste and hazardous substances) into building drains, site drains, streams, waterways, holding ponds or to the ground surface shall not be permitted. The contractor shall be held responsible for any damages that may result. Further, the

contractor shall conduct activities in such a fashion to avoid creating any legal nuisance, including but not limited to, suppressing noise and dust, controlling erosion, and implementing other measures as necessary to minimize off-site impacts of work activities.

6. SITE MAINTENANCE, CLEANUP, MOWING AND TRIMMING:

6.1 Site Maintenance: The contractor shall protect adjacent property, buildings, and their contents from dust, dirt, or other materials. Contractor is to wet down dry materials, settle debris and prevent blowing dust. The contractor shall maintain work areas in a neat, clean, and safe condition. Work areas shall, at a minimum, be cleaned daily.

6.2 Cleanup: The contractor shall collect all trash, debris, refuse, garbage, etc., which he generates and place it in appropriate containers with lids or approved covers daily. The aforementioned materials shall be hauled from the site by appropriate means daily, unless otherwise approved by the Contracting Officer. Disposal shall be outside the limits of government property. Disposal shall be at a municipal solid waste landfill or by other approved methods and shall conform to all local, state, and federal guidelines, criteria, and regulations.

6.3 Mowing and Trimming: The contractor shall perform mowing and trimming operations on his job site or storage site at no additional cost to the government. Vegetation shall be mowed and trimmed when it reaches a height of five (5) inches. Mowing and trimming shall be to a height of three (3) inches. Mowing shall be accomplished with a rotary mower that leaves the clippings evenly distributed on the soil surface. Mowing shall be accomplished during normal duty hour periods and in such manner that the soil and grass will not be damaged. Towed mowers and self-propelled riding mowers shall not be operated within three (3) feet of trees and shrubs. Areas next to trees and shrubs shall be mowed with hand-propelled mowers.

7. ENERGY CONSERVATION:

The contractor shall use good judgment in the conservation of government utilities. The contractor shall adhere to and enforce prevailing energy conservation practices.

8. RESPONSIBILITY:

The above summaries 1 through 7 do not in any way limit the responsibility of the contractor to perform all work and furnish all plant, labor, and materials required by the contract documents referenced herein.

9. STORAGE AND PARKING:

9.1 Contractor storage and parking shall be near the job site, as designated by the Contracting Officer.

9.2 The contractor shall keep all other storage areas free of debris, leaks, stains, or splashes. All storage areas shall be maintained in a neat, clean, and safe condition. Any areas that incur contamination by any hazardous substance shall be immediately remediated by the contractor at no additional expense to the government. Remediation may include subsequent soil analysis if directed by the government. The contractor shall store all paints, thinners, solvents and other

hazardous materials in a contractor supplied trailer or storage unit, which shall be secured when not in use.

10. TESTING PARAGRAPHS:

All testing indicated in these contract documents to be performed by the government will be performed only at the option of the government.

11. SAFETY:

11.1 The contractor shall comply with all applicable Air Force Occupational Health and Safety Standards and Regulations. The contractor is also required to comply with the American General Contractors' Safety Manual and the Occupational Safety and Health Act.

11.2 The contractor shall not have or allow glass food or drink containers on the construction site. Glass lined thermal containers are permitted when contained in an appropriate metal or plastic outer shield.

11.3 The contractor must obtain authorization to bring any nonexempt radioactive material (such as density gauges or moisture meters) onto Sheppard AFB by contacting the Nuclear Regulatory Commission, Region IV Office, using the NRC Form 241. Before bringing any radioactive material onto Sheppard AFB, the contractor shall forward a copy of the NRC Form 241 to:

*82D MEDICAL GROUP/SGPB
821 A AVENUE
SHEPPARD AFB TX 76311-3448.*

12. COLOR AND MATERIAL SELECTIONS:

12.1 No color selections and no material selections will be made by the government until the contractor submits all samples of all materials requiring color selections to the government in accordance with the CONTRACT CLAUSES. In addition, prior to the government selecting colors, the contractor shall certify in writing that all colors and samples submitted are current and are acceptable to the contractor for government selection of colors at no additional cost to the government.

12.2 Any samples that are not applicable to the contract shall be carefully removed from the submittal by the contractor. The contractor shall submit, for government selection, the manufacturer's full range of applicable colors, patterns, and textures for the various materials that are required by the contract and within the guidelines hereinbefore stated.

12.3 In the event that discontinued, non-current, or nonapplicable colors, textures, or samples are submitted by the contractor to the government and their selection is made by the government, the contractor shall bear all labor and material correction costs for fabrication, shipping, restocking, removal, repair of damaged materials, and installing of all materials required by the government to correct the project.

12.4 The contractor is responsible for notifying the government in writing when all submittals requiring color selections have been submitted. All products requiring color selections shall be submitted on individual material approval submittal forms, one item per form.

13. PHASING REQUIREMENTS:

Not Required.

14. TREES, SHRUBS AND HEDGES:

14.1 The contractor shall take appropriate measures to prevent injury to plants in or near the project site unless designated to be removed. The contractor shall not remove or prune any plants without approval from the Contracting Officer or his designated representative.

14.2 Plants that are damaged during construction shall be replaced at no expense to the government and with a 1 year warranty following replacement. Replacement plantings shall be accomplished between November 1 and April 1. Damaged trees shall be replaced with Class I trees, minimum 2" caliper, as defined in Texas Agriculture Extension Service (TAES) Publication L-1683, Evaluation of Texas Shade Trees, June 1987. Damaged shrubs or hedges shall be replaced with plants of equal size, type, and value.

14.3 The Contracting Officer or his designated representative will determine the extent of damage in accordance with National Arborist Association Standards, American Standard for Nursery Stock, TAES Publications L-1683, Evaluation of Texas Shade Trees, and L-1516, Damage Recovery Opportunities for Loss of Landscape Trees, May 1977.

15. TOPSOIL AND MULCH:

15.1 Topsoil shall be obtained from approved off-base sources. The topsoil sources shall be inspected by the Base Agronomist to determine if the selected soils meet the following requirements. The topsoil shall be a sandy loam or sandy clay loam from the top four to six inch layer of soil. Topsoil shall be fertile, friable, natural surface soil, free of subsoil, clods, shale, trash, toxic substances, stones, Johnson grass, all grass from Cyperaceae family, or other objectionable and hard to eradicate vegetation. Topsoil shall be a Class II soil as defined by the Soil Conservation Service from the Enterprise, Hardeman, Yahola or Yomont series.

15.2 Mulch shall be ground cypress bark, free from weed seed, soil, plant disease, insects or other objectionable materials. The mulch shall be delivered to the site in unopened bags.

SECTION 01300
PROJECT SUBMITTALS

1. GENERAL:

1.1 Definitions:

1.1.1 Submittal: A submittal is a package of information, samples, drawings, schedules, certificates, etc., submitted to the Contracting Officer for Government review.

1.1.2 Deviation: A specific submittal where an item is identified as not agreeing with the contract requirements and the contractor is requesting a substitution or change.

1.1.3 Approval/Disapproval: Specific judgments reserved to the Contracting Officer concerning a submittal's compliance with the plans and specifications.

1.2 Purpose: Submittals are directed for the convenience of the Government in reviewing the contractors planned approach and compliance with the requirements of the contract. It is also a mechanism whereby the contractor may propose deviations, color choices, shop drawings, etc., at an early point in the contract where changes in approach will have less impact on the materials ordering process.

1.3 Authority: The contractor is wholly responsible for the contents of a submittal. Through the physical act of submitting, the contractor certifies that all items listed or implied, fully meet the intended purpose, functionality, and quality requirements of the plans and specifications, or are submitted as specific deviations thereto.

1.3.1 The contractor shall assure that submittal materials provided, including those provided directly by his suppliers, accurately describe the items in the necessary detail required for a full review.

1.3.2 The submittal of a "system", either as a routine action or as a deviation, shall be considered a submittal of an integrated collection of component parts, each part of which shall be equally bound by paragraphs of this specification.

1.3.3 The Government's approval of a submittal, in whole or in part, shall not be construed as approval of any suggestion, of any deviation, or of any factor that places an item not in compliance with the plans and specifications, unless said item is specifically processed as a deviation.

1.3.4 Any and all deviations from those stated requirements of the plans and specification, shall be identified by the contractor, specifically in writing as a submittal

deviation, for either the system as a whole or for a specific item of the whole upon which the deviation is to be exercised. The deviation shall be submitted to the Contracting Officer for review.

2. PROJECT SUBMITTALS:

2.1 Submittals requiring approval of materials shall be submitted to the Contracting Officer within 14 calendar days after the date of receipt of the notice to proceed. Submittals shall be made by the contractor as a minimum on each specific item addressed in the specifications and drawings.

2.2 Reference: The contractor shall refer to the applicable paragraph in the contract specifications and/or sheet number in chronological order of the contract drawings that requires the submittal.

2.3 At the time of award, the Contracting Officer will furnish forms on which the submittals can be tabulated. Furnishing of the submittals shall not be interpreted as relieving the contractor of his obligation to comply with all of the contract requirements for the items listed in the specifications and drawings. Payment will not be made for any material or equipment that does not comply with contract requirements.

2.4 Submittals shall be submitted in six sets except as otherwise noted. One copy of each drawing and each list will be returned, marked to indicate approval or disapproval.

2.5 A minimum of 14 calendar days shall be allowed for review and approval and possible resubmittal of submittals disapproved by the Government.

SECTION 02050

DEMOLITION

PART 1 GENERAL

1 REFERENCES (Not Applicable)

2 GENERAL REQUIREMENTS

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

3 SUBMITTALS

Submittals shall be in accordance with the Contract Clauses.

4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

5 PROTECTION

5.1 Protection of Existing Property: Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

5.2 Protection of Trees: Trees within the project site which might be damaged during demolition shall be protected by a 6 foot high fence. The fence shall be securely

erected a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind or as approved by the Contracting Officer.

6. BURNING: The use of burning at the project site for the disposal of refuse and debris will not be permitted.

7. USE OF EXPLOSIVES: Use of explosives will not be permitted.

8. AVAILABILITY OF WORK AREAS: Areas in which the work is to be accomplished shall not have work commence until approved by the Contracting Officer's Representative.

8.1 Contractor shall visit the site and carefully examine work to be demolished so as to become familiar with existing conditions, the nature and scope of the work and difficulties that attend its execution prior to beginning demolition work.

9. METHOD OF MEASUREMENT:

Measurement shall not include the yardage of material demolished without authorization.

10. Pavement: Quantity of concrete or bituminous pavement removal as specified above will be paid for at the contract unit price per square yard of pavement removed. This price shall be full compensation for demolition, removal as indicated on the plans to be removed and all labor, equipment, tools, and incidentals necessary to complete this item shall be considered subsidiary to the installation of the water and sewer pipe and appurtenances.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

11. EXISTING WORK: The contractor shall take all necessary precautions to insure against damage to existing work to remain in place, to be reused or to remain the property of the government, and any damage to such work shall be repaired or replaced as approved by the Contracting Officer at no additional cost to the government. The contractor shall carefully coordinate the work of this section with all other work and provide, erect and maintain all temporary barricades, planking, fences, bracing, shoring, lights and warning signs required by the Contracting Officer for the protection of persons, aircraft, taxiways, aprons, vehicles, utilities and other adjacent on-site and off-site properties.

11.1 Leave all protection in place and maintain until all work has been completed and all danger of damage has passed. Protection shall be removed only after approval is given by the Contracting Officer.

11.2 The contractor shall not disturb any existing paving, structure, piping apparatus or other work unless expressly required by the contract. Where cutting, drilling, rubblizing, breaking, cracking, excavating and/or removals are required, the work shall be done in a manner that will safeguard and not endanger items to remain in place and shall in all cases be as approved by the Contracting Officer. Prior to demolition activity, the contractor shall investigate the area planned for demolition and shall determine the exact location of utility lines and shall avoid interference's with such lines as indicated. Contractor shall take the necessary action to insure that Foreign Object Debris (FOD) is kept off the active portions of taxiways and aprons.

12. DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

13. CLEAN UP

Debris and rubbish shall be removed from excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

SECTION 02222

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort 56,000 ft-lbf/cu. ft.
ASTM D 2487	(1992) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1998) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 MEASUREMENT AND PAYMENT

All measurement and payment will be based on completed work performed in accordance with the drawings and specifications.

1.1.1 Trench Excavation:

Trench excavation shall be the number of cubic yards measured along the centerline of the trench and excavated to the depths and widths specified for the particular size of pipe. No increase shall be made for the extra width required at manholes and similar structures. Payment for trench excavation as so measured shall constitute full payment for excavation and backfilling, except in rock or unstable trench bottoms. Unstable trench bottoms shall be replaced by select granular material and paid for as specified below. Trench excavation shall also include the additional width at manholes and similar structures, the furnishing, placing and removal of sheeting and bracing, pumping and bailing, and all incidentals necessary to complete the work required by this section.

1.2.2 Rock Excavation

Rock excavation shall be measured and paid for by the number of cubic yards of acceptably excavated rock material. The material shall be measured in place, but volume shall be based on a maximum 30-inch width for pipes 12 inches in diameter or less, and a maximum width of 16 inches greater than the outside diameter of the pipe for pipes over 12 inches in diameter. The measurement shall include all authorized overdepth rock excavation as determined by the Contracting Officer. For manholes and other appurtenances, volumes of rock excavation shall be computed on the bases of 1 foot outside of the wall lines of the structures. Payment for rock excavation shall be made in addition to the price bid for the trench excavation, and shall include all necessary drilling and blasting and all incidentals necessary to excavate and dispose of the rock. Backfill replacing rock excavation shall not be paid for separately, but shall be included in the unit price for rock excavation.

1.2.3 Select Granular Material

Select granular material shall be measured in place as the actual cubic yards replacing wet or unstable material in trench bottoms in authorized overdepth areas. The unit price shall include furnishing and placing the granular material, excavation and disposal of unsatisfactory material, and additional requirements for sheeting and bracing, pumping, bailing, cleaning, and other incidentals necessary to complete the work. Payment for select granular material shall be made in addition to the bid price for trench excavation.

1.3 DEFINITIONS

1.3.1 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.4 SUBMITTALS

Submittals shall be as specified in the Contract Clauses.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials shall consist of any material classified by ASTM D 2487 as GW, GP, and SW.

2.1.2 Unsatisfactory Materials

Unsatisfactory materials shall be materials that do not comply with the requirements for satisfactory materials. Unsatisfactory materials include but are not limited to those materials containing roots and other organic matter, trash, debris, frozen materials and stones larger than 3-inches, and materials classified in ASTM D 2487, as PT, OH, and OL. Unsatisfactory materials also include man-made fills, refuse, or backfills from previous construction.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

2.1.4 Rock

Rock shall consist of boulders measuring 1/2 cubic yard or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 1/2 cubic yard in volume, except that pavements will not be considered as rock.

2.1.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 3-inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.7 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than 95 percent by weight passing the 1-inch sieve. The maximum allowable aggregate size shall be 1-inch per foot of pipe diameter, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.8 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 3-inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller.

2.1.9 Plastic Marking Tape

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 wide with minimum thickness of 0.004-inch. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Blue:	Water Systems
Green:	Sewer Systems

PART 3 EXECUTION

3.1 EXCAVATION

Excavation shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph ROCK. Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

3.1.1 Trench Excavation

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 5 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 5 feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to

slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor.

3.1.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the fault or neglect of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe can be safely and

properly installed and backfill can be properly compacted in such sections.

3.1.1.6 Stockpiles

Stockpiles of satisfactory materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment. Excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government.

3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.2.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall not be backfilled until all specified tests are performed.

3.2.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.2.1.3 Bedding and Initial Backfill

Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe.

3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

a. Roadways and Airfields: Backfill shall be placed up to the elevation as directed by the Contracting Officer's Representative.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 12-inch loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. This requirement shall also apply to all other areas not specifically designated above.

3.2.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 4 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 Gas Distribution

Trenches shall be excavated to a depth that will provide not less than 450 mm (18 inches) of cover in rock excavation and not less than 600 mm (24 inches) of cover in other excavation. Trenches shall be graded as specified for pipe-laying requirements in Section 02685 GAS DISTRIBUTION SYSTEM.

3.3.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of 2 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.3.5 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe a distance of one foot, unless otherwise indicated by the contracting officer's representative.

3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.4.1 Testing Facilities

Test shall be performed by an approved commercial testing laboratory or may be tested by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved by the Contracting Officer.

3.4.2 Testing of Backfill Materials

Characteristics of backfill materials shall be determined in accordance with particle size analysis of soils ASTM D 422 and moisture-density relations of soils ASTM D 1557. A minimum of one particle size analysis and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill.

3.4.3 Field Density Tests

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every 60 meters (200 feet) of installation shall be performed. One moisture density relationship shall be determined for every 1500 cubic meters (1500 cubic yards) of material used. Field in-place density shall be determined in accordance with ASTM D 2922. The calibration curves shall be checked and adjusted using the sand cone method as described in paragraph Calibration of the ASTM publication. ASTM D 2922 results in a wet unit weight of soil and when using this method. ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job, on each different type of material encountered, at intervals as directed by the Contracting Officer. Copies of calibration curves, results of calibration tests, and field and laboratory density tests shall be furnished to the Contracting Officer. Trenches improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the Government.

3.4.4 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of

the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

SECTION 02233

GRADED-CRUSHED-AGGREGATE BASE COURSE

PART 1. GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29	(1991a) Unit Weight and Voids in Aggregate
ASTM C 88	(1990) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1990) Materials Finer Than 75-micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1989) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1992) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2487	(1992) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017	(1988) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1984) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1987) Wire-Cloth Sieves for Testing Purposes
ASTM E 548	(1991) General Criteria Used for Evaluating Laboratory Competence

1.2 WAYBILLS AND DELIVERY TICKETS

Copies of waybills and delivery tickets shall be submitted during the progress of the work. Before the final statement is allowed, the Contractor shall file certified waybills and certified delivery tickets for all aggregates actually used.

1.3 UNIT PRICES

1.3.1 Measurement

The quantity of graded-crushed-aggregate base course completed and accepted will be measured in cubic yards. The volume of graded-crushed-aggregate base course in place and accepted will be determined by the average job thickness obtained in accordance with paragraph THICKNESS CONTROL and the dimensions indicated

1.3.2 Payment

1.3.2.1 Quantity of Graded-Crushed-Aggregate Base Course

Quantity of graded-crushed-aggregate base course as specified above will be paid for at the contract unit price for graded-crushed-aggregate base course, which will constitute full compensation for the construction and completion of the base course, including the furnishing of all other necessary labor and incidentals.

1.4 SUBMITTALS

Submittals shall be in accordance with the Contract Clauses.

1.5 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557. This

will be abbreviated herein as percent of laboratory maximum density.

1.6 EQUIPMENT

1.6.1 Approval

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.6.2 Weather Limitation

Base courses shall be placed when the atmospheric temperature is above 35 degrees F. Areas of completed base course that are damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirement.

1.7 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory, or by the Contractor subject to approval. If the Contractor elects to establish testing facilities of his own, approval of such facilities shall be based on compliance with ASTM E 548, and no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved. The first inspection of the facilities shall be at the expense of the Government and any subsequent inspections required because of failure of the first inspection will be at the expense of the Contractor. Such costs will be deducted from the total amount due the Contractor. The materials shall be tested to establish compliance with the specified requirements. Copies of test results shall be furnished to the Contracting Officer.

1.7.1 Sampling

Sampling for material gradation, liquid limit, and plastic limit tests shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.7.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

1.7.2.1 Sieve Analyses

Sieve analyses shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

1.7.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.7.2.3 Soundness Test

Soundness tests shall be made in conformance with ASTM C 88.

1.7.2.4 Wear Test

Wear tests shall be made in conformance with ASTM C 131.

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of clean, sound, durable particles of crushed stone, crushed slag, or crushed gravel, and screenings. The Contractor shall obtain materials that meet the specification and can be used to meet the grade and smoothness requirements specified herein, after all compaction operations have been completed. Slag shall be an air-cooled, blast-furnace product having a dry weight of not less than 65 pcf as determined by ASTM C 29. The aggregates shall be free of silt and clay as defined by ASTM D 2487, vegetable matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.

2.1.1 Coarse Aggregates

Coarse aggregates shall be angular particles of uniform density. The coarse aggregate shall have a loss not greater than 12 percent weighted averaged at five cycles when tested for soundness in magnesium sulfate in accordance with ASTM C 88. The coarse aggregate shall have a percentage of wear not to exceed 45 after 500 revolutions as determined by ASTM C 131. The percentage of flat and/or elongated particles shall not exceed 20 in the fraction retained on the 1/2 inch sieve and in the fraction passing the 1/2 inch sieve. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the requirements set forth herein. Crushed gravel shall be manufactured from gravel particles 90 percent of which by weight are retained on the maximum-size sieve listed in TABLE I. In the portion retained on each sieve specified, the crushed gravel shall contain at least 90 percent by weight of

crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsection area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces.

2.1.2 Fine Aggregate

Fine aggregate shall be angular particles produced by crushing stone, slag, or gravel that meets the requirements for wear and soundness specified for coarse aggregate. Fine aggregate shall be produced by crushing only particles larger than No. 4 sieve in size. The fine aggregate shall contain at least 90 percent by weight of particles having two or more freshly fractured faces in the portion passing the No. 4 sieve and retained on the No. 10 sieve.

2.1.3 Gradation Requirements

Gradation requirements specified herein shall apply to the completed base course. The aggregates shall be graded continuously well within the limits specified in TABLE I. Sieves shall conform to ASTM E 11.

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	No. 1	No. 2	No. 3
2-inch	100	--	--
1-1/2 inch	70-100	100	--
1-inch	45-80	60-100	100
1/2-inch	30-60	30-65	40-70
No. 4	20-50	20-50	20-50
No. 10	15-40	15-40	15-40
No. 40	5-25	5-25	5-25
No. 200	0-10	0-10	0-10

NOTE 1: Particles having diameters less than 0.02 mm shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity, and the percentages passing the various sieves may require appropriate correction by the Contractor when aggregates of varying specific gravities are used.

2.1.4 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements stated herein shall apply to any aggregate component that is blended to meet the required gradation and also to the aggregate in the completed base course. The portion of the aggregate passing the No. 40 sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 OPERATION OF AGGREGATE SOURCES

Clearing, stripping, and excavating shall be the responsibility of the Contractor. The aggregate sources shall be operated in such a manner as to produce the quantity and quality of base course materials meeting these specification requirements in the specified time limits. Upon completion of the work, the aggregate sources on Government reservations shall be conditioned to drain readily and be left in a satisfactory condition. Aggregate sources on private lands shall be conditioned in agreement with local laws or authorities.

3.2 STOCKPILING MATERIAL

Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer so as to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.3 PREPARATION OF UNDERLYING COURSE

Prior to constructing the crushed-aggregate base course, the underlying course shall be cleaned of all foreign substances. At the time of construction of the base course, the underlying course shall contain no frozen material. Ruts or soft, yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. The finished underlying course shall not be disturbed by traffic or other operations and shall

be maintained by the Contractor in a satisfactory condition until the base course is placed.

3.4 GRADE CONTROL

During construction, the lines and grades including crown and cross slope indicated for the base course shall be maintained by means of line and grade stakes placed by the Contractor.

3.5 MIXING OF MATERIALS

The coarse and fine aggregates shall be mixed in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. The Contractor shall make such adjustments in mixing procedures or in equipment as may be directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory base course meeting all requirements of this specification.

3.6 PLACING

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or be less than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable base course.

3.7 COMPACTION

3.7.1 Requirements

Each layer of base course shall be compacted as specified to produce an average field-measured density, through the full depth, of at least 100 percent of laboratory maximum density obtained in the laboratory. Water content shall be maintained during the compaction procedure and subsequent proof rolling of designated areas such that the water content is within plus or minus 2 percent of optimum water content as determined from laboratory tests as specified in density test procedures listed in paragraph SAMPLING AND TESTING. In all places not

accessible to the rollers, the base course material shall be compacted with mechanical tampers.

3.7.2 Finishing

The surface of top layer of base course shall be finished after final compaction, and proof rolled, where required, by cutting any overbuild to grade and rolling with a steel-wheeled roller. In no case will thin layers of material be added to the top layer of base course to meet grade. If the elevation of top layer of base course is 1/2 inch or more below the grade, the top layer of base shall be scarified to a depth of at least 3 inches, new material shall be added, and the layer shall be blended and recompactd to bring to grade. Adjustments in rolling and finishing procedures shall be made as may be directed to obtain grades, to minimize segregation and degradation of base course material, to adjust the water content, and to insure an acceptable base course. Material found unacceptable shall be removed and replaced, as directed, with acceptable material.

3.8 EDGES OF BASE COURSE

Acceptable material shall be placed along the edges of the base course in such quantity as will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least a 1-foot width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the base course, as directed.

3.9 SMOOTHNESS TEST

The surface of the top layer shall not deviate more than 3/8 inch when tested with a 10-foot straightedge applied parallel with and at right angles to the centerline of the area to be paved. Deviations exceeding 3/8 inch shall be corrected as directed.

3.10 THICKNESS CONTROL

The completed thickness of the base course shall be within 1/2 inch of the thickness indicated. The thickness of the base course shall be measured at intervals providing at least one measurement for at least each 500 square yards of base course. The depth measurement shall be made by test holes at least 3 inches in diameter. Where the measured thickness of the base course is more than 1/2 inch deficient, such areas shall be corrected by excavating to the required depth and replacing with new material. Where the measured thickness of the base course is 1/2 inch more than indicated, it will be considered as conforming with the requirements plus 1/2 inch, provided the surface of the base course is within 1/2 inch of established grade. The average job thickness shall be the average of the

job measurements as specified above but within 1/4 inch of the thickness indicated.

3.11 MAINTENANCE

The base course shall be maintained in a condition that will meet all specification requirements until accepted.

SECTION 02511

CONCRETE SIDEWALKS AND CURBS AND GUTTERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1990a) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615	(1990) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 616	(1990) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 617	(1990) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM C 31	(1991) Making and Curing Concrete Test Specimens in the Field
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 171	(1991) Sheet Materials for Curing Concrete
ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 173	(1978) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(1991b) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 309	(1991) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752

(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

CORPS OF ENGINEERS (COE)

COE CRD-C 527

(1988) Standard Specification for Joint Sealants, Cold-Applied, Non-Jet-Fuel-Resistant, for Rigid and Flexible Pavements

1.2 MEASUREMENT FOR PAYMENT

1.2.1 Sidewalks

The quantities of sidewalks to be paid for will be the number of square square yards of each depth of sidewalk constructed as indicated.

1.2.2 Curbs and Gutters

The quantities of curbs and gutters to be paid for will be the number of linear feet of each cross section constructed as indicated, measured along the face of the curb at the gutter line.

1.3 BASIS FOR PAYMENT

1.3.1 Sidewalks

Payment of the quantities of sidewalks measured as specified will be at the contract unit price per square yard of the thickness specified.

1.3.2 Curbs and Gutters

Payment of the quantities of curbs and gutters measured as specified will be at the contract unit price per linear foot of each cross section.

1.4 SUBMITTALS

Submittals shall be as prescribed under Contract Clauses.

1.5 WEATHER LIMITATIONS

1.5.1 Placing During Cold Weather

Concrete placement shall be discontinued when the air temperature reaches 40 degrees F and is falling. Placement may begin when the air temperature reaches 35 degrees F and is rising. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F,

placement shall be approved in writing. Approval shall be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.5.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. In no case shall the placing temperature exceed 95 degrees F.

1.6 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.6.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.6.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in one pass.

PART 2 PRODUCTS

2 CONCRETE

- 2.1 Sidewalk Concrete: Concrete shall have a minimum compressive strength of 3,000 psi. The maximum size of aggregate shall be 1 1/2 inches. The concrete mixtures shall have air content by volume of concrete of 3 to 6 percent, based on measurements made immediately after discharge from the mixer. Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231

shall be used with concretes and mortars made with relatively dense natural aggregates.

2.2 Curb and Gutter Concrete: Concrete shall have a minimum compressive strength of 3,000 psi. The maximum size of aggregate shall be 1 1/2 inches. Concrete shall have a slump of not more than 3 inches. The concrete mixture shall have air content by volume of concrete of 3 to 6 percent, based on measurements made immediately after discharge from the mixer.

2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A 615, ASTM A 616, or ASTM A 617. Wire mesh reinforcement shall conform to ASTM A 185.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to FS CCC-C-467.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 3/8 inch thick, unless otherwise indicated.

2.5 JOINT SEALANTS

2.5.1 Joint Sealant, Cold-Applied

Joint sealant, cold-applied shall conform to COE CRD-C 527.

2.6 FORM WORK

Form work shall be designed and constructed to insure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2-inch nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4-inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of two welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted to conform with applicable requirements of Section 02511.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected so as to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms shall be carefully set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of three stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to insure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 3 m 10-foot long section. After forms are set, grade and alignment shall be checked with a 10-foot straightedge. Forms shall have a transverse slope to match existing with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished as specified for concrete finishing.

Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer of such thickness that when consolidated and finished the sidewalks will be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a wood float, bull float, or darby, edged and broom finished.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished carefully with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators.

3.4.2 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.3 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.

3.5.1 Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8-inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Expansion Joints

Expansion joints shall be formed with 3/8 inch joint filler strips. Joint filler shall be placed with top edge 1/4 inch below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be carefully cleaned and filled with joint sealer. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. Contraction joints shall be constructed by means of 1/8-inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 3/8 inch in width shall be provided at intervals not exceeding 30 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

The entire exposed surface shall be covered with two or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet per gallon for both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas

within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Protective Coating

Protective coating of linseed oil mixture shall be applied to the exposed-to-view concrete surface.

3.7.4.1 Application

Curing and backfilling operation shall be completed prior to applying protective coating. Concrete shall be surface dry and thoroughly clean before each application. Coverage shall be not more than 50 square yards per gallon for first application and not more than 70 square yards per gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the

manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at temperatures lower than 50 degrees F.

3.8 FIELD QUALITY CONTROL

3.8.1 General Requirements

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 190 cubic meters (250 cubic yards) of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31 by an approved testing laboratory. Each strength test result shall be the average of two test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each

truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests, of 2 inch +/- 1 inch shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests will be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noticed along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. All pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified.

Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

SECTION 02579

PATCHING OF RIGID PAVEMENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1992) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 150	(1992) Portland Cement
ASTM C 171	(1992) Sheet Materials for Curing Concrete
ASTM C 260	(1986) Air-Entraining Admixtures for Concrete
ASTM D 75	(1987; R 1992) Sampling Aggregates

CORPS OF ENGINEERS (COE)

COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 300	(1990) Specification for Membrane-Forming Compounds for Curing Concrete
COE CRD-C 400	(1963) Requirement for Water for Use in Mixing or Curing Concrete

1.2 UNIT PRICES

1.2.1 Measurement

1.2.1.1 Concrete

The quantity of concrete to be paid for will be the number of square yards placed in the completed and accepted patched areas.

1.2.1.2 Portland Cement

The quantity of portland cement determined as specified will be subsidiary and included in the unit price for repair of the pavement. It includes all costs of demurrage, unloading, hauling, handling and storage at the site.

1.2.1.3 Epoxy-Resin Grout

The quantity of epoxy-resin grout determined as specified will be subsidiary to the repair of the pavement which price will include all costs of handling, hauling, storage at the site, labor, materials, tools and equipment, and for performing work involved in placing epoxy-resin grout on the surface of the existing pavement to be patched.

1.3 DESIGN

The concrete mixtures shall be designed to produce concrete having an average flexural strength of 25 MPa (3000 psi) at 28 days of age.

1.4 SUBMITTALS

Submittals shall be in accordance with the Contract Clauses.

1.5 EQUIPMENT; APPROVAL AND MAINTENANCE

Dependable and sufficient equipment that is appropriate and adequate to accomplish the work specified shall be assembled at the site of the work a sufficient time before the start of paving to permit thorough inspection, calibration of weighing and measuring devices, adjustment of parts, and the making of any repairs that may be required. The equipment shall be maintained in good working condition.

1.6 SAMPLING AND LABORATORY TESTING OF MATERIALS

Sampling and testing shall be performed by an approved commercial laboratory or by the Contractor subject to approval. Should the Contractor elect to establish testing facilities, no work requiring testing shall be permitted until the Contractor's facilities have been inspected and approved. The first laboratory inspection shall be at the expense of the Government and the cost of any subsequent inspection resulting from failure of the first inspection shall be at the expense of the Contractor. Such costs shall be deducted from the total amount due the Contractor. All testing shall be performed at no additional cost to the Government.

1.6.1 Cement

Cement shall be tested as prescribed in the referenced specification under which it is furnished. Cement may be accepted on the basis of mill tests and the manufacturer's certification of compliance with the specification, provided the cement is the

product of a mill with a record for the production of high-quality cement for the past 3 years.

1.6.2 Aggregate

Aggregate samples for laboratory testing shall be taken in conformance with ASTM D 75 and tested in accordance with ASTM C 136.

1.6.3 Joint-Sealing Materials

Joint-sealing materials shall be tested for conformance with the referenced applicable material specification.

1.7 DELIVERY AND STORAGE OF MATERIALS

1.7.1 Cement

Cement may be furnished in bulk or in suitable bags used for packaging cements and shall be stored in a manner to prevent absorption of moisture.

1.7.2 Aggregates

Aggregates shall be handled and stored in a manner to avoid breakage, segregation, or contamination by foreign materials.

1.7.3 Epoxy-Resin Grout

Epoxy-resin grout shall be delivered to the site in such manner as to avoid damage or loss. Storage areas shall be in a windowless and weatherproof, but ventilated, insulated noncombustible building, with provision nearby for conditioning the material to 20 degrees F 85 degrees F for a period of 48 hours prior to use. The ambient temperature in the storage area of the epoxy materials shall at no time be higher than 100 degrees F.

1.7.4 Jet-Fuel Resistant Sealing Material

Jet-fuel-resistant sealing material shall be stored out of the weather, away from direct sunlight, and at temperatures not less than 60 degrees F nor more than 100 degrees F.

1.8 WEATHER LIMITATIONS

Concrete shall not be placed when weather conditions detrimentally affect the quality of the finished product. No concrete shall be placed when the air temperature is below 40 degrees F in the shade. When air temperature is likely to exceed 90 degrees F, the concrete shall have a temperature not exceeding 90 degrees F when deposited, and the surface of such placed concrete shall be kept damp with a water fog until the approved curing medium is applied.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Coarse Aggregate

2.1.1.1 Composition

Coarse aggregate shall consist of gravel, crushed gravel, crushed stone, or a combination thereof, or crushed blast-furnace slag.

2.1.1.2 Quality

Aggregate as delivered to the mixers shall consist of clean, hard, unweathered, and uncoated particles. Dust and other coatings shall be removed from the coarse aggregates by adequate washing.

2.1.1.3 Particle Shape

Particles of the coarse aggregate shall be generally spherical or cubical in shape.

2.1.1.4 Size and Grading

The maximum nominal size of the coarse aggregate shall be 1/2 inch. The coarse aggregate shall be well graded within the limits specified, and when tested in accordance with ASTM C 136, shall conform to the following grading requirements as delivered to the batching hoppers:

Sieve designation U.S. Standard square mesh	Percentage by weight passing individual sieves No. 4 to 1/2 inch
3/4 inch	100
1/2 inch	90-100
3/8 inch	40-70
No. 4	0-15
No. 8	0-5

2.1.2 Fine Aggregate

2.1.2.1 Composition

Fine aggregate shall consist of either natural sand, manufactured sand, or a combination of natural and manufactured sand, and shall be composed of clean, hard, durable particles.

2.1.2.2 Particle Shape

Particles of the fine aggregate shall be generally spherical or cubical in shape.

2.1.2.3 Grading

Grading of the fine aggregate as delivered to the mixer shall conform to the following requirements when tested in accordance with ASTM C 136.

Sieve designation U.S. Standard square mesh	Percentage by weight, passing
3/8 inch	100
No. 4	95-100
No. 8	80-90
No. 16	60-80
No. 30	30-60
No. 50	12-30
No. 100	2-10

In addition, the fine aggregate, as delivered to the mixer, shall have a fineness modulus of not less than 2.40 nor more than 2.90, when calculated in accordance with COE CRD-C 104.

2.1.3 Air-Entraining Admixture

Air-entraining admixture shall conform to ASTM C 260.

2.1.4 Cement

Cement shall be portland cement conforming to ASTM C 150, Type 20 2500 psi.

2.1.5 Curing Materials

2.1.5.1 Curing Compound

Membrane-forming curing compound shall be a pigmented type conforming to COE CRD-C 300.

2.1.5.2 Waterproof Blanket Materials

Waterproof blanket materials shall conform to ASTM C 171.

2.1.6 Epoxy-Resin Grout

Epoxy-resin grout shall be applied per manufacturers instructions.

2.1.7 Joint-Sealing Materials

Joint-sealing materials shall be as follows:

2.1.8 Water

Water shall be clean, fresh, and free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances. Water approved by Public Health authorities for domestic consumption may be accepted for use without being tested. Water that is of questionable quality, in the opinion of the Contracting Officer, shall be tested in accordance with COE CRD-C 400.

PART 3 EXECUTION

3.1 CONDITIONING OF EXISTING PAVEMENT

3.1.1 Preparation of Existing Surfaces

In the area to be patched, the surface of the existing concrete shall be removed to a minimum depth of 2 inches and to such additional depth where necessary to expose a surface of sound, unweathered concrete that is uncontaminated by oils, greases, or deicing salts or solutions. A vertical saw cut at least 2 inches deep shall be made a minimum of 1 inch outside of the area to be repaired. The surface shall be thoroughly cleaned by sweeping and blowing with compressed air. Prior to coating with the epoxy-resin grout, areas showing traces of oils or grease shall be cleaned by sandblasting.

3.1.2 Preparation of Joints

Joint-sealing and expansion-joint materials shall be removed flush with the prepared surface, and, if on the pavement surface to be patched, shall be removed by sandblasting. The use of solvents will not be permitted. Care shall be used to prevent bonding of the adjacent concrete slabs at the location of the existing joints. Maintenance of these existing joints shall be accomplished by the use of fiberboard or other approved inserts of appropriate dimensions.

3.1.3 Bonding Course

Prior to placing concrete, the previously prepared surfaces shall be washed with a high pressure water jet followed by an air jet to remove free water. The clean surface shall then be coated with a 20- to 40-mil thick film of the epoxy-resin grout. The epoxy-resin grout shall be placed in one application, just prior to concrete placement, with the use of mechanical combination, mixing and spraying equipment, or shall be applied in two coats with stiff brushes. The first brush coat shall be scrubbed into the concrete surface, followed by an additional brush coat to obtain the required thickness. When the brush method is used, the initial coat may be allowed to dry; however, the final coat shall be applied just prior to placement of the concrete.

3.1.3.1 Mixing Epoxy-Resin Grout Components

Epoxy-resin grout components shall be mixed in the proportions recommended by the manufacturer. The components shall be conditioned to 70 degrees F to 85 degrees F for 48 hours prior to mixing. The two epoxy components shall be mixed with a power-driven, explosion-proof stirring device in a metal or polyethylene container having a hemispherical bottom. The polysulfide-curing-agent component shall be added gradually to the epoxy-resin component with constant stirring until a uniform mixture is obtained. The rate of stirring shall be such that the entrained air is a minimum.

3.1.3.2 Tools and Equipment

Tools and equipment used further in the work shall be thoroughly cleaned before the epoxy-resin grout sets.

3.1.3.3 Health and Safety Precautions

The following health and safety precautions shall be followed:

- a. Full face shields shall be provided for all mixing and blending operations and for placing operations as required.
- b. Protective coveralls and neoprene-coated gloves shall be provided for all workmen engaged in the operations.
- c. Protective creams of a suitable nature for the operation shall be supplied.
- d. Adequate fire protection shall be maintained at all mixing and placing operations.
- e. Smoking or the use of spark- or flame-producing devices shall be prohibited within 50 feet of mixing and placing operations.
- f. The mixing, placing, or storage of epoxy-resin grout or solvent shall be prohibited within 50 feet of any vehicle, equipment, aircraft, or machinery that could be damaged from fire or could ignite vapors from the material.

3.2 BATCHING, MIXING AND PROPORTIONING

3.2.1 Equipment

The Contractor shall provide adequate facilities for the accurate measurement and control of each of the materials entering the concrete. The Contracting Officer shall have free access to the batching and mixing plant at all times. Mixing equipment shall be capable of combining the aggregate, cement, admixture, and water into a uniform mixture and discharging this mixture without segregation.

3.2.2 Conveying

Concrete shall be conveyed from mixer to repair area as rapidly as practicable by methods that will prevent segregation or loss of ingredients.

3.2.3 Facilities for Sampling

Suitable facilities shall be provided for readily obtaining representative samples of aggregate and concrete for uniformity test purposes. Necessary platforms, tools, and equipment for obtaining samples shall be furnished by the Contractor.

3.2.4 Mix Proportions

The proportions of materials entering into the concrete mixtures shall be in accordance with the approved job-mix formula. The proportions shall be changed whenever necessary to maintain the workability, strength, and standard of quality required, and to meet the varying conditions encountered during the construction. However, no changes will be made without prior approval.

3.2.6 Workability

The slump of the concrete shall be maintained at the lowest practicable value, not exceeding 2 inches when tested in accordance with ASTM C 143.

3.3 PLACING

Concrete shall be placed within 45 minutes from the time all ingredients are charged into the mixing drum, before the concrete has obtained its initial set, and while the epoxy-resin bonding course is tacky. The temperature of the concrete, as deposited in the form, shall be not less than 40 degrees F nor more than 90 degrees F. Concrete shall be deposited in such manner as to require a minimum of rehandling, and placement shall be in such manner as to require a minimum of rehandling and in such a manner as to least disturb the epoxy-resin grout. The placing of concrete shall be rapid and continuous for each area. Workmen shall not walk on the bonding-course surface or in the concrete during placing and finishing operations. The concrete shall be thoroughly consolidated by tamping or by means of suitable vibrating equipment.

3.4 FIELD TEST SPECIMENS

3.4.1 General

Concrete samples shall be furnished by the Contractor, and shall be taken in the field and tested to determine the slump, air content, and strength of the concrete. Test beams shall be made for determining conformance with the strength requirements of these specifications and, when required, for determining the time at

which pavements may be placed in service. Test beams shall be molded and cured as specified below. The Contractor shall furnish all materials, labor, and facilities required for molding, curing, and protecting test beams at the site and under the supervision of the Contracting Officer. Curing facilities for test beams shall include furnishing and operating water tanks equipped with temperature-control devices that will automatically maintain the temperature of the water at 73 degrees F plus or minus 5 degrees F. The Contractor shall also furnish and maintain at the site, boxes or other facilities suitable for storing the specimens while in the mold at a temperature of 73 degrees F plus or minus 10 degrees F. Tests of the fresh concrete and of the hardened concrete beams shall be made by and at the expense of the Contractor.

3.4.2 Specimens for Strength Tests

Flexural test beams shall be made each shift that concrete is placed. Each group of test beams shall be molded from the same batch of concrete, and shall consist of a sufficient number of specimens to provide two flexural-strength tests at each test age. One group of specimens shall be made during the first half of each shift, and the other during the last portion of the shift. However, at the start of paving operations and each time the aggregate source, aggregate characteristics, or mix design is changed, one additional set of test beams shall be made.

3.5 FINISHING

Finishing operations shall be started immediately after placement of the concrete. The finished surfaces of patched areas shall have a surface texture approximating that of the adjacent undisturbed pavements.

3.6 CURING

3.6.1 General

Concrete shall be cured by protection against loss of moisture and rapid temperature changes for a period of not less than 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. The Contractor shall have all equipment needed for adequate curing and protection of the concrete on hand and ready to install before actual concrete placement begins. Failure to comply with curing requirements shall be cause for immediate suspension of concreting operations.

3.6.2 Burlap Curing

Immediately after the finishing operations have been completed and the concrete has set sufficiently to prevent marring the surface, the entire surface of the newly laid concrete shall be covered with approved wetted burlap that shall be kept wet for a period of not less than 24 hours. The surface of the newly laid concrete shall

be kept moist until the burlap coverings are in place. Curing of the concrete shall be continued for the duration of the required curing period by this method or one of the methods specified below.

3.6.2.1 Waterproof-Paper Blankets or Impermeable Sheets

Immediately after removing the covering used for initial curing, the exposed concrete surfaces shall be moistened with a fine spray of water and then covered with waterproof-paper blankets, polyethylene-coated-burlap blankets, or impermeable sheets. Burlap of polyethylene-coated burlap shall be saturated with water before placing. Sheets shall be placed with the light-colored side up. Sheets shall overlap not less than 12 inches with edges taped or secured to form a completely closed joint. Coverings shall be weighted down to prevent displacement or billowing from winds. Tears or holes appearing during the curing period shall be immediately repaired by patching.

3.6.2.2 Membrane-Forming Curing Compound

Membrane-forming curing compound shall be applied immediately to exposed concrete surfaces after removing burlap coverings. The curing compound shall be applied with an overlapping coverage that will give a two-coat application at a coverage of not more than 200 square feet per gallon for both coats. When application is made by hand-operated sprayers, the second coat shall be applied in a direction approximately at right angles to the first coat. Concrete shall be properly cured at joints, but no curing compound shall enter joints that are to be sealed with joint-sealing compounds. The compound shall form a uniform, continuous, cohesive film that will not check, crack, or peel, and that will be free from pinholes and other imperfections. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed at the coverage specified above and at no additional cost to the Government. Areas covered with curing compound that are damaged by pedestrian and vehicular traffic or by subsequent construction operations within the specified curing period shall be resprayed at no additional cost to the Government.

3.7 FINISH TOLERANCE

The finished surfaces of patched areas shall meet the grade of the adjoining pavements and shall not deviate more than 1/8-inch from a true plan surface within the patched area.

3.8 PAVEMENT PROTECTION

The Contractor shall protect the patched areas against damage prior to final acceptance of the work by the Government. Traffic shall be excluded from the patched areas by erecting and maintaining barricades and signs until the completion of the curing period of the concrete.

3.9 JOINTS

Joints shall conform in detail and be in alignment with the existing joints. After curing of the concrete, the joints in the critical areas indicated shall be primed if and as recommended by the sealant formulator and shall then be sealed with jet-fuel resistant joint-sealing material. Other joints shall be sealed with non jet-fuel resistant sealing materials. Equipment for heating and installing jet-fuel resistant sealers shall be that for which the material was formulated. Equipment for heating and installing non jet-fuel resistant sealers shall be indirect heating type with pressure-type pouring device, and devices for controlling and indicating the temperature of the sealers. Mixing of components of jet-fuel resistant sealers and temperatures of application shall be as recommended by the particular sealer manufacturer. Sealer shall completely fill the joint without discontinuities and without formation of voids or entrapped air. Defective joints shall be satisfactorily replaced.

SECTION 02660

WATER LINES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1784	(1992) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1993) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2466	(1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(1993) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2774	(1972; R 1983) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1993) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine
AWWA C500	(1986) Gate Valves for Water and Sewerage Systems
AWWA C509	(1987) Resilient-Seated Gate Valves for Water and Sewerage Systems

AWWA C651	(1992) Disinfecting Water Mains
AWWA C700	(1990; C700a) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA C800	(1989) Underground Service Line Valves and Fittings
AWWA M23	(1980) Manual: PVC Pipe - Design and installation

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND
FITTINGS INDUSTRY (MSS)

MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
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NSF INTERNATIONAL (NSF)

NSF Std 14	(1965; Rev Nov 1990) Plastics Piping System Components and Related Materials
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1.2 PIPING

This section covers water, supply, distribution, service lines, and connections to building service at a point indicated on the drawings and to the individual RV sites. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

1.2.1 Service Lines

Piping for water service lines less than 3 inches in diameter shall be polyvinyl chloride (PVC) plastic.

1.2.2 Distribution Lines 3 Inches or Larger

Piping for water distribution lines 3 inches or larger shall be polyvinyl chloride (PVC) plastic unless otherwise shown or specified.

1.2.3 Supply Lines 3 Inches or Larger

Piping for water supply lines 3 inches or larger shall be polyvinyl chloride (PVC) plastic unless otherwise shown or specified.

1.2.4 Plastic Pipe

All plastic piping system components intended for transportation of potable water shall comply with NSF Std 14 and shall be legibly marked with their symbol.

All plastic piping system components intended for transportation of potable water shall comply with NSF Std 14 and shall be legibly marked with their symbol.

1.2.5 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.3 SUBMITTALS

Government approval is required for submittals indicated below. The following shall be submitted in accordance with the contract clauses.

Catalog data on all equipment and materials supplied.

The manufacturer's recommendations for each material or procedure to be utilized.
Bacterial Examination

Test results from commercial laboratory verifying disinfection.

1.4 HANDLING

Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition. Particular care shall be taken not to injure the pipe. If any pipe or fitting is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

1.4.1 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC) pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325M.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

2.1.1.1 Polyvinyl Chloride (PVC) Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

a. Pipe Less Than 4 inch Diameter:

Elastomeric-Gasket Joint: Pipe shall conform to dimensional requirements of ASTM D 1785. Schedule 40 with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified, or it may be pipe conforming to requirements of ASTM D 2241, elastomeric joint, with the following applications:

Working SDR Pressure	Minimum Hydrostatic Pressure psi	Maximum psi
26	100	133
21	120	160
17	150	200
13.5	200	266

In addition to the above requirements, the pipe, couplings and fittings shall be hydrostatically tested as required by AWWA C900.

(1) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.

b. Pipe 4 Inch through 12 Inch Diameter: Pipe, couplings and fittings 4 inch through 12 inch diameter shall conform to AWWA C900, Class 150, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.

2.2 FITTINGS AND SPECIALS

2.2.1 Polyvinyl Chloride (PVC) Pipe

For pipe less than 4 inch diameter, fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467.

2.3.2 Plastic Pipe

2.3.2.1 Polyvinyl Chloride Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations as approved by the Contracting Officer.

2.4 VALVES

2.4.1 Gate Valves

Gate valves shall be designed for a working pressure of not less than 150 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

a. Valves smaller than 3 inches shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150.

2.5 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

2.6 MISCELLANEOUS ITEMS

2.6.1 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.6.2 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 200 psi. PVC service stops may be used with 2-inch operating nut.

2.6.3 Service Boxes

Service boxes shall be cast iron or concrete and shall be extension service boxes of the length required for the depth of the line, with either screw or slide-type adjustment. The boxes shall have housings of sufficient size to completely cover the service stop or valve and shall be complete with identifying covers.

2.6.4 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 10 feet from a sewer except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 6 feet from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe for a distance of at least 10 feet each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main, closer horizontally than 3 feet to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Roads

Asphalt roadways shall be boarded and sleeved for water pipe. Sleeve shall be rigid conduit. A minimum clearance of at least 2 inches between the inner wall of the sleeve and the maximum outside diameter of the sleeved pipe and joints shall be provided. Sleeves of ferrous material shall be provided with corrosion protection as required for the conditions encountered at the site of installation.

3.1.2.4 Structures

Where water pipe is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required for roads. Care shall be exercised and proper precautions taken during installation of the water pipe and sleeve to assure that there will be no damage to the structures and no settlement or movement of foundations or footings.

3.1.3 Joint Deflection

3.1.3.1 Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but in no case shall it exceed 5 degrees.

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Under no circumstances shall any of the water-line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. Where made under pressure, these connections shall be installed using standard methods as approved

by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPPA-01.

3.1.4.2 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.5 Jointing

3.1.5.1 Polyvinyl Chloride (PVC) Plastic Pipe

a. Pipe less than 4 inch diameter: Threaded joints shall be made by wrapping the male threads with approved thread tape or applying an approved lubricant, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with requirements of ASTM F 477 and as required herein. All pipe ends for push-on joints shall be beveled to facilitate assembly and marked to indicate when the pipe is fully seated. The gasket shall be prelubricated to prevent displacement. The gasket and ring groove in the bell or coupling shall match. The manufacturer of the pipe or fitting shall supply the elastomeric gasket. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to the requirements of ASTM D 2467. The solvent cement used shall meet the requirements of ASTM D 2564; the joint assembly shall be made in accordance with ASTM D 2855 and the manufacturer's specific recommendations.

3.1.6 Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines. Where building services are not installed, the Contractor shall terminate the service lines approximately 5 feet from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines 2 Inches and Smaller

Service lines 2 inches and smaller shall be connected to the main by a directly-tapped corporation stop or by a service clamp.

3.1.8 Setting of Fire Hydrants, Valves and Valve Boxes

3.1.8.1 Fire Hydrants

Fire hydrants shall be located and installed as shown. Each hydrant shall be connected to the main with a 4 inch branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with pumper nozzle facing the roadway, with the center of the lowest outlet not less than 18 inches above the finished surrounding grade, and the operating nut not more than 48 inches above the finished surrounding grade. Fire hydrants designated on the drawings as low profile shall have the lowest outlet not less than 18 inches above the finished surrounding grade, the top of the hydrant not more than 24 inches above the finished surrounding grade. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished gradeline immediately after installation to obtain beneficial use of the hydrant as soon as practicable. The hydrant shall be set upon a slab of concrete not less than 4 inches thick and 15 inches square. Not less than 7 cubic feet of free-draining broken stone or gravel shall be placed around and beneath the waste opening of dry barrel hydrants to ensure drainage.

3.1.8.2 Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box or pit to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

3.1.8.3 Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.1.9 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

3.1.10 Thrust Restraint

Plugs, caps, tees and bends deflecting 11-1/4 degrees or more, either vertically or horizontally, on waterlines 4 inches in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.10.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2,000 psi after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fitting or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 1.33 times the working pressure. Water supply lines designated on the drawings shall be subjected for 1 hour to a hydrostatic pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves, discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

- a. Wet or unstable soil conditions in the trench.

b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the contract.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 1.33 times the working pressure. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section thereof, necessary to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air expelled. No piping installation will be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

$$L = 0.0001351ND(P \text{ raised to } 1/2 \text{ power})$$

L = Allowable leakage in gallons per hour

N = Number of joints in the length of pipeline tested

D = Nominal diameter of the pipe in inches

P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill.

3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage

tests, and disinfection shall be satisfactory as specified. All replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

a. Pressure test and leakage test may be conducted concurrently.

b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.3 DISINFECTION

3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as prescribed by AWWA C651. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material.

The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph MISCELLANEOUS ITEMS. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner. Polyvinyl Chloride (PVC) pipe lines shall be chlorinated using only the above specified chlorinating material in solution. In no case will the agent be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. All valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period, each fire hydrant on the line shall be opened and closed several times. From several points in the unit, personnel from the Contractor's commercial laboratory shall take at least 3 water samples from different points, approved by the Contracting Officer, in proper sterilized containers and perform a bacterial examination in accordance with state approved methods. The commercial laboratory must be certified by the state's approving authority for examination of potable water. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

SECTION 02685

GAS DISTRIBUTION SYSTEM

PART I GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GAS ASSOCIATION (AGA)

AGA-01 (1989) A,G,A, Plastic Pipe Manual for Gas Service

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2513 (1993) Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

ASTM D 2683 (1993) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

ASTM D 3261 (1993) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

ASTM D 3350 (1993) Polyethylene Plastics Pipe and Fittings Materials

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.21 (1492) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.40 (1985; K 1994) Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems

ASME B31.8 (1992; B31.8a; B31.8b; B31.8c) Gas Transmission and Distribution Piping Systems

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 192 Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25 (1993) Standard Marking System for Valves, Fittings, Flanges and Unions

1.2 GENERAL REQUIREMENTS

1.2.1 Welding Steel Piping

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with Section IX, ASME Boiler and Pressure Vessel Code. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ANSI B31.1. The Contracting Officer shall be furnished with a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Welding of steel piping shall be required only in Phase 1 of this project as indicated on the drawings.

1.2.2 Jointing Polyethylene Piping

Piping shall be joined by performance qualified joiners using qualified procedures in accordance with AGA-01. Manufacturer's prequalified joining procedures shall be used. Joints shall be inspected by an inspector qualified in the joining procedures being used and in accordance with AGA-01. Joiners and inspectors shall be qualified, trained, and certified by the manufacturer of the pipe in each joining procedure to be used on the job. Training shall include use of equipment, safety, and proper procedure of using equipment.

1.2.3 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos shall not be used. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Valves, flanges, and fittings shall be marked in accordance with MSS SP-25.

1.2.4 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.2.5 Handling

Pipe and components shall be handled carefully to ensure a sound, undamaged condition. Particular care shall be taken not to damage pipe coating. No pipe or material of any kind shall be placed inside another pipe or fitting after the coating has been applied, except as specified in paragraph INSTALLATION. Plastic pipe shall be handled in conformance with AGA-01.

1.3 SUBMITTALS

Government approval is required for submittals. The following shall be submitted in accordance with the Contract Clauses;

Schedules

* Equipment and Materials *

A complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Manufacturers descriptive data and installation instructions for the following:

- a. Poly Valves and Pipe
- b. Transitions
- c. Anodeless Risers
- d. Marking Tape

* Notification *

Notification of the Contractor's schedule for making connections to existing gas lines, as indicated in the drawings, coordinated with the contracting officer.

Statements

* Welding Steel Piping *

A copy of qualified welding procedures along with a list of names and identification symbols of performance qualified welders and welding operators.

* Jointing Polyethylene Piping *

A copy of qualified jointing procedures along with a list of names of qualified joiners. *

* Connection and Abandonment Procedures *

A copy of procedures for gas line tie in, hot taps, abandonment/removal or demolition, purging, and plugging as applicable in accordance with ASME 851.8.

Certificates

* Training *

A copy of each jointer's training certificate.

Operation and Maintenance Manuals

* Gas Distribution System *

Six copies, in booklet form and indexed, of Site specific natural gas operation and maintenance manual for each gas distribution system including system operation, equipment operation system maintenance and equipment maintenance manuals described below.

The System Operation Manual shall include but not be limited to tile following:

- a. Maps showing piping layout and locations of all system valves and gas line markers.

- b. Step-by-step procedure required for system startup, operation and shutdown. System components and equipment shall be indexed to tile gas maps.

- c. Isolation procedures and valve operations to shut down or isolate each section of the system. Valves and other system components shall be indexed to the gas maps.

The Equipment Operation Manual shall include but not be limited to detail drawings data and manufacturer supplied operation manuals for all equipment valves and system components.

The System Maintenance Manuals shall include but not be limited to:

- a. Maintenance check list for entire gas distribution system.

- b. Identification of pipe materials and manufacturer by location, pipe repair procedures, and jointing procedures at transitions to other piping materials or piping from different manufacturer.

The Equipment Maintenance Manuals shall include but not be limited to the following:

- a. Identification of valves and other equipment by materials, manufacturer, Vendor identification and location.

- b. Maintenance procedures and recommended maintenance tool kits for all valves and equipment

- c. Recommended repair methods, either field repair, factory repair or whole item replacement for each valve component or piece of equipment or component item.

- d. Routine maintenance procedures, possible breakdowns and repairs and troubleshooting guide.

PART 2 PRODUCTS

2.1 PIPE, FITTINGS, AND ASSOCIATED MATERIALS

2.1.1 Steel Pipe

Steel pipe shall be used only as indicated in the drawings. All other areas the piping shall be polyethylene piping as specified. Steel pipe shall conform to Schedule 40. Pipe flanges and flanged fittings including bolts, nuts, and bolt patterns shall be in accordance with ASME standards. Butt weld fittings shall be in accordance with ASME standards. Weld neck flanges shall be used.

2.1.2 Steel Forged Branch Connections

Connections shall conform to ASTM standards, Class 60, carbon steel.

2.1.3 Flange Gaskets

Gaskets shall be non-asbestos compressed material in accordance with 1/16 inch minimum thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with nitrile butadiene rubber (NBR), or glass fibers bonded with polytetrafluorethylene, suitable for maximum 600 degrees F service and meeting applicable requirements of ASME B31.8.

2.1.4 Polyethylene Pipe, Tubing, Fittings and Joints

Polyethylene pipe, tubing, fittings and joints shall conform to ASTM D 3350 and ASTM D 2513, pipe designations PE 2406, rated SDR 13.5 or less, as specified in ASME B31.8. Pipe sections shall be marked as required by ASTM D 2513. All new poly pipe shall be yellow.

Poly pipe shall be butt welded. Butt fittings shall conform to ASTM D 3261. Minimum wall thickness shall meet ASME B31.8, table 842.32(c).

2.1.5 Identification

Pipe flow markings and metal tags for each valve shall be provided as required by the Contracting Officer.

2.1.6 Gas Transition Fittings

Gas transition fittings shall be manufactured steel fittings approved for jointing steel and polyethylene. Approved transition fittings are those that conform to AGA-OI requirements for transition fittings.

2.2 VALVES

Valves shall be suitable for shutoff or isolation service and shall conform to the following:

2.2.1 Polyethylene Valves

Polyethylene valves shall conform to ASME B16.40. Polyethylene valves, in sizes 1/2 inch to 6 inches, shall be used with polyethylene distribution and service lines for underground installation only.

2.2.2 Valves Installed Underground:

All valves installed underground on poly pipe shall be polyethylene ball or plug type conforming to ANSI B16.40 and shall be of materials and manufacture compatible with system materials used. Valves shall be 11.0 SDR and be equal

to Rockwell poly valves. Valves installed in conjunction with hot taps of steel mains shall be steel and conform to API Spec 6 D carbon steel butt weld with 2 inch square wrench operator adapter.

2.3 PRESSURE REGULATORS

Regulators shall have ferrous bodies, shall provide backflow and vacuum protection, and shall be designed to meet the pressure, load and other service conditions.

2.3.2 Service Line Regulators

2.3 PROTECTIVE COVERING MATERIALS

2.3.1 Thermoplastic Resin Coating System

Continuously extruded polyethylene and adhesive coating system materials shall that recommended by the pipe manufacturer.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILLING

Earthwork shall be as specified in Section 02222 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2 GAS MAINS

Pipe for gas mains shall be polyethylene, except where as noted on the drawings. Steel pipe and fittings shall be coated with Protective covering as specified, Polyethylene mains shall not be installed aboveground.

3.3 SERVICE LINES

Service lines shall be polyethylene and shall extend from the gas main to and including the anodeless riser installed within 3 feet of the building. The service lines shall be connected to the gas mains through service tees. Service line shall be provided with an isolation valve of the same size as the service line, unless otherwise indicated. The service lines shall be as short and as straight as practicable between the point of delivery and the gas main and shall not be bent or curved laterally unless necessary to avoid obstructions or otherwise permitted. Service lines shall be laid with as few joints as practicable using standard lengths of pipe. Shorter lengths shall be used only for closures. Polyethylene service lines shall not be installed aboveground except as permitted in ASME B31.8.

3.4 ANODELESS RISER

Gas risers for building service shall be anodeless type risers with a schedule 40 epoxy coated casing and schedule 40 epoxy coated gas carrier pipe inside of a polyethylene sleeve sealed to prevent moisture penetration. A 12 inch polyethylene: SDR 11 pigtail shall be provided to allow fusion of the riser to the new underground polyethylene service,

3.5 WORKMANSHIP AND DEFECTS

Pipe, tubing, and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and blown free of chips and scale. Defective pipe, tubing, or fittings shall be replaced and shall not be repaired.

3.6 PROTECTIVE COVERING

3.6.1 Protective Covering for Underground Steel pipe, Joints, and Transitions

Except as otherwise specified, protective coverings shall be applied mechanically in a factory or field plant especially equipped for the purpose. Fittings that cannot be coated and wrapped mechanically shall have the protective covering applied by hand, preferably at the plant that applies the covering to the pipe. Joints shall be coated and wrapped by hand. Hand coating and wrapping shall be done in a manner and with materials that will produce a covering equal in thickness to that of the covering applied mechanically.

3.6.1.1 Thermoplastic Resin Coating System

The coating system shall be as specified. The exterior of the pipe shall be cleaned to a commercial grade blast cleaning finish in accordance with SSPC SP 6. Adhesive compound shall be applied to the pipe. Immediately after the adhesive is applied, a seamless tube of polyethylene shall be extruded over the adhesive to produce a bonded seamless coating. The nominal thickness of the pipe coating system shall be 10 mils (plus or minus 10 percent) of adhesive and 40 mils (plus or minus 10 percent) of polyethylene for pipes up to 16 inches in diameter. Joint coating and field repair material shall be applied as recommended by the coating manufacturer and shall be one of the following:

- a. Heat shrinkable polyethylene sleeves.
- b. Polyvinyl chloride pressure-sensitive adhesive tape.
- c. High density polyethylene/bituminous rubber compound tape.

The coating system shall be inspected for holes, voids, cracks, and other damage during installation.

3.6.1.2 Inspection of Pipe Coatings

Any damage to the protective covering during transit and handling shall be repaired before installation.

3.6.2 Painting of Aboveground Piping Systems

All new service risers and piping shall be primed and painted with two coats of exterior enamel that complies with Fed Spec TT-E-489. Paint color shall be in accordance with Federal Standard 595B, color number 20099.

3.4 INSTALLATION

Gas distribution system and equipment shall be installed in conformance with the manufacturer's recommendations and applicable sections of ASME B31.8, AGA-OI and 49 CFR 192. Abandoning existing gas piping shall be done in accordance with ASME B31.8. Pipe shall be cut without damaging the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable. On steel pipe 6 inches and larger, an approved gas-cutting-and-beveling machine may be used. Cutting of plastic pipe shall be in accordance with AGA-OI. Valve installation in plastic pipe shall be designed to protect the plastic pipe against excessive torsional or shearing loads when the valve is operated and from other stresses which may be exerted through the valve or valve box.

3.7.1 Installing Pipe Underground

Gas mains and service lines shall be installed where indicated. Joints in steel pipe shall be welded except as otherwise permitted for installation of valves. Mains shall have 24 inch minimum cover; service lines shall have 18 inch minimum cover; and both mains and service lines shall be placed on firmly compacted select material for the full length. Where indicated, the main shall be encased (sleeved) to withstand any anticipated external loads as specified in ASME B31.8. The encasement material shall be standard weight black steel pipe with a protective coating as specified. The pipe shall be separated from the casing by insulating spacers and sealed at the ends with casing bushings. Trench shall be excavated below pipe grade, bedded with bank sand, and compacted to provide full-length bearing. Laying the pipe on blocks to produce uniform grade will not be permitted. The pipe shall be clean inside before it is lowered into the trench and shall be kept free of water, soil, and all other foreign matter that might damage or obstruct the operation of the valves, regulators, meters, or other equipment. When work is not in progress, open ends of pipe or fittings shall be securely closed by expandable plugs or other suitable means. Minor changes in line or gradient of pipe that can be accomplished through the natural flexibility of the pipe material without producing permanent deformation and without overstressing joints may be made when approved. Changes in line or gradient that exceed the limitations specified shall be made with fittings. When cathodic protection is furnished, electrically insulated joints or flanges shall be provided. When polyethylene piping is installed underground, foil backed magnetic tape shall be placed above the pipe to permit locating with a magnetic detector. After laying of pipe and testing, trench shall be backfilled in accordance with Section 02222 EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITY SYSTEMS.

3.8 PIPE JOINTS

Pipe joints shall be designed and installed to effectively sustain the: longitudinal pullout forces caused by tile contraction of piping or superimposed loads.

3.8.1 Threaded Steel Joints

Threaded joints in steel pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing compound for gas service or polytetrafluoroethylene tape applied to the male threads only. Caulking of threaded joints to stop or prevent leaks will not be permitted.

3.8.2 Welded Steel Joints

Gas pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B3 1.8. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored 90 that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.

3.8.3 Polyethylene Pipe Jointing Procedures

Jointing procedures shall conform to AGA-O 1. Indiscriminate heat fusion joining of plastic pipe or fittings made from different polyethylene resins

by classification or by manufacturer shall not be allowed. If heat fusion joining of dissimilar polyethylenes is unavoidable, special procedures are required. The method of heat fusion joining dissimilar polyethylene resins shall be tested in accordance with paragraph TESTS, subparagraph Destructive Tests of Plastic Pipe Joints.

3.8.4 Connections Between Metallic and Plastic Piping

Connections shall be made only outside, underground, and with approved transition fittings.

3.9 VALVE BOXES

Valve boxes of cast iron not less than 3/16 inch thick shall be installed at each underground valve except where concrete or other type of housing is indicated. Valve boxes shall be provided with locking covers that require a special wrench for removal. Wrench shall be furnished for each box. The word "gas" shall be cast in the box cover. When the valve is located in a roadway, the valve box shall be protected by a suitable concrete slab at least 3 square feet. When in a sidewalk, the top of the box shall be in a concrete slab 2 feet square and set flush with the sidewalk. Boxes shall be adjustable extension type with screw or slide-type adjustments. Valve boxes shall be separately supported, not resting on the pipe, so that no traffic loads can be transmitted to the pipe. Valves shall only be located in valve boxes or inside of buildings.

3.10 CONNECTIONS TO EXISTING LINES

Connections between new work and existing gas lines, where required, shall be made in accordance with ASME B31.8 using proper fittings to suit the actual conditions. When connections are made by tapping into a gas main, the connecting fittings shall be the same size as the pipe being connected.

3.10.1 Connections to Existing Lines

Contractor shall provide materials for the connections to the existing gas lines. Final connections and the turning on of gas shall be made by the contractor. Existing lines that are to be abandoned or taken out of service shall be disconnected, purged and capped, plugged or otherwise effectively sealed by the contractor.

3.10.1.2 Abandonment shall not be completed until it has been determined that the volume of gas or liquid hydrocarbons contained within the abandoned section poses no potential hazard. Air or inert gas may be used

for purging, or the facility may be filled with water or other inert material. If air is used for purging, the Contractor shall ensure that a combustible mixture is not present after purging.

3.10.1.3 When a main is abandoned, together with the service lines connected to it, only the customer's end of such service lines is required to be sealed as stipulated above.

3.10.1.4 Service lines abandoned from the active mains shall be disconnected as close to the main as practicable.

3.10.1.5 All valves left in the abandoned segment shall be closed.

3.10.1.6 All abovegrade valves, risers, and vault and valve box covers shall be removed. Vault and valve box voids shall be filled with suitable compacted backfill material.

3.10.1.7 The Contractor shall notify the Contracting Officer, in writing, as required by the contract before an outage and making final connections of gas lines. The Contractor shall make necessary arrangements for tie in and activation of new gas lines.

3.11 TESTS

3.11.1 Destructive Tests of Plastic Pipe Joints

At the request of the Contracting Officer, contractor shall demonstrate a properly fusion welded joint. A joint shall be made by a person performing joining of plastic pipe that day and visually tested. At least 3 longitudinal straps shall be cut from each joint. Each strap shall be visually examined, shall not contain voids or discontinuities on the cut surfaces of the joint area, and shall be deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area. If a joint fails the visual or deformation test, the qualified joiner who made that joint shall not make further field joints in plastic pipe on this job until that person has been retrained and requalified.

3.11.2 Pressure and Leak Tests

The system of gas mains and service lines shall be tested after construction and before being placed in service using air as the test medium. The normal operating pressure for the system is 20 pounds. Prior to testing the system, the interior shall be blown out, cleaned and cleared of all foreign materials. All meters, regulators, and controls shall be removed before blowing out and cleaning and reinstalled after clearing of all foreign materials. Testing of gas mains and service lines shall be done with due regard for the safety of employees and the public during the test. Persons not working on the test operations shall be kept out of the testing area while testing is proceeding. The test shall be made on the system as a whole or on sections that can be isolated. Joints in sections shall be tested prior to backfilling when trenches must be backfilled before the completion of other pipeline sections. The test shall continue for at least 24 hours from the time of the initial readings to the final readings of pressure and temperature. The initial test readings of the instrument shall not be made for at least 1 hour after the pipe has been subjected to the full test pressure, and neither the initial nor final readings shall be made at times of rapid changes in atmospheric conditions. The temperatures shall be representative of the actual trench conditions. There shall be no indication of reduction of pressure during the test and the numbers denote initial and final readings. During the test, the entire system shall be completely isolated from all compressors and other sources of air pressure. Each joint shall be tested by means of soap and water- or an equivalent nonflammable solution prior to backfilling or concealing any work at the request of the contracting officer's representative. The testing instruments shall be approved by the Contracting Officer. All labor, materials and equipment for conducting the tests shall be furnished by the Contractor and shall be subject to inspection at all times during the tests. The Contractor shall maintain safety precautions for air pressure testing at all times during the tests.

SECTION 02724

REPAIR AND REHABILITATION OF MANHOLES IN SANITARY SEWER SYSTEMS

PART 1 - GENERAL

1.1 SCOPE:

This section of the specifications covers repairs and rehabilitation of existing manholes and appurtenances. Included are the sealing of manhole walls, annular spaces around pipes entering and leaving manholes, elimination of leakage at junction of walls and base and at walls and frame, replacement of cast iron frames and/or covers, rebuilding manhole walls, and other related miscellaneous work. Manholes requiring work to eliminate problems of various categories are shown on the drawings.

1.2 RELATED WORK:

Other sections directly related to work covered in this section include the following:

Section 02222 - Excavation, Trenching, Backfill, Utility System

Section 02725 - Sanitary Sewer Appurtenances

1.3 REFERENCES:

All reference material covered under Section 02725 "Sanitary Sewer Appurtenances" shall be applicable to this section.

1.4 SUBMITTALS:

The submittals shall be as specified in the Contract Clauses portion of the project.

PART 2 - PRODUCTS

Products to be used under this section of the specifications shall be submitted for approval prior to use.

PART 3 - EXECUTION

3.1 INSPECTION:

All work shall be inspected by the Contracting Officer. This does not relieve the contractor of any obligation under this contract.

3.2 PREPARATION:

To conform with manufacturer's requirements and recommendations after review and approval by Contracting Officer.

3.3 PROCEDURES AND INSTALLATIONS:

3.3.1 Sealing of Manhole Walls:

a. **Cement-Epoxy Mixtures:** Openings, cracks and deteriorated joints in manhole walls shall be repaired and sealed by utilizing cement epoxy mixtures manufactured and adapted for this purpose. Debris resulting from the required operations shall be prevented from entering the sanitary sewer pipe.

b. **Fiberglass Liners:** Manhole liners made of fiberglass reinforced polyester (FRP), designed especially for this purpose and having an inside diameter of not less than 42", shall be installed where called for on the specifications or drawings for the total reconstruction of manhole walls. At the contractor's option, but with no additional compensation, the contractor may use these liners in lieu of sealing with cement-epoxy mixtures. The liners shall be installed in complete conformance with manufacturer's recommendations including the removal of the existing corbels, grouting of annular space between the liners and existing manhole walls, and the rebuilding or replacement of the corbels, backfill and compaction, and the re-installation of the cast iron frames and covers.

3.3.2 Sealing of Joint at Junction of Manhole Walls and Base: When the invert or floor of the manhole consists of built-up mortar or grout, with or without bricks, and the extraneous water emerges through or around its periphery, the contractor shall completely remove it. The concrete base shall be thoroughly cleaned and a new invert or floor built, complete with channels, in accordance with the requirements for new manholes, in Section 02725 "Sanitary Sewer Appurtenances". When the invert or floor is an integral part of the concrete base, the leak shall be sealed by using a product similar to those described in paragraph 3.3.1. Other methods and materials for sealing the joint at the junction of manhole walls and base may be used by the contractor after approval by the Contracting Officer, although it remains the responsibility of the contractor to achieve a lasting, watertight seal.

3.3.3 Sealing of Joint Between Cast Iron Frame and Top of Manhole Wall: In most cases, when the cast iron frame and cover are in reusable condition and are not themselves sources of inflow, the leakage through the joint under the frame can be most satisfactorily handled by removing and replacing the old mortar joint. This shall be accomplished by excavating as necessary, lifting off the frame, thoroughly cleaning its bottom bearing surface, coating it with asphalt paint similar to the original coating, removing the old mortar from the top of the wall and replacing it with a 1/2-inch (normal) layer of new mortar consisting of one part of Portland Cement to three parts of clean, washed sand, mixed with an adequate amount of water and carefully re-seating the frame. Optional methods may be used after approval by the Contracting Officer.

3.3.4 Elimination of Leakage Around Pipes Entering Manholes: Unless otherwise ordered, the pipes shall be excavated and exposed outside the manhole. Appropriate repairs as directed or approved by the Contracting Officer, shall then be made. The type of repairs required will depend on the type of failure encountered. Included are concrete collars and/or the removal and replacement of pipe stub-outs through manhole walls in accordance with the details on the drawings. Other methods and materials may be used after approval by the Contracting Officer. When the existing stub-out, poorly plugged or capped outside the manhole, permits extraneous water to enter, it shall be plugged on the inside by inserting a wooden bulkhead, not less than 1" of thickness, and sealing with cement grout.

3.3.5 Leakage at Cast Iron frames and Covers:

The elimination of leakage will be handled as described herein below. Leakage at cast iron frames and covers, other than between the frame and the top of the manhole wall described elsewhere in this section of the specifications, normally occurs through pick or vent holes in the cover itself, between the seating surfaces of the cover and the frame, or a combination of both. Unless otherwise called for on the drawings, this extraneous flow may be eliminated by one of the following methods:

3.3.5.1 Replacement of Cover:

When an existing frame is in good, sound condition but its cover has pick and/or vent holes, or its seating surface is pitted or otherwise eroded, that cover may be removed and replaced with a new cast iron manhole cover of approximately the same thickness and weight with pick slots in lieu of pick holes, and containing no

vent holes. Its seating surface must be machined or equipped with an elastomeric gasket to permit it to rest tightly against the seating surface of the frame remaining in place without "rocking" under vehicular traffic, and its configuration must be such as to mate closely with that of the frame. Old covers shall remain the property of Sheppard AFB and shall be delivered and stored by the contractor at a location within the Base designated by the Contracting Officer.

3.3.5.2 Replacement of Frame and Cover:

When called for on the specifications or drawings, or when the condition of the frame is satisfactory but a replacement cover meeting the requirements described above is not available, the contractor shall remove and replace the entire assembly with a new frame and cover which will eliminate the extraneous flow. The frame shall be set on the manhole wall as described in "Sealing of Joint between Cast Iron Frame and Top of Manhole Wall", above.

3.3.5.3 Installing Watertight Inserts:

These units, made of high density polyethylene, equipped with air release and vacuum valves, and with a configuration such that the lip will rest on the seating surface of the manhole frame and be supported thereby, and also such that the cast iron cover, when tipped at 90 degrees to its normal position, will not touch the insert's bowl, may be furnished and installed in accordance with the manufacturer's recommendations.

3.4 FIELD QUALITY CONTROL:

3.4.1 Testing:

After rehabilitation work at each manhole has been completed and the materials used have been allowed to cure, it shall be tested for the elimination of excess infiltration by the contractor in the presence of the Contracting Officer. Unless otherwise permitted by the Contracting Officer, the exfiltration method shall be used. Watertight plugs shall be placed in the pipes entering and leaving the manhole. It shall then be filled to the top of the frame with water. After allowing sufficient time for absorption, the manhole shall again be filled to the top of the frame. The time shall then be recorded and after a period of not less than one hour has passed, the manhole again refilled, the amount required being carefully measured. From this information the rate of exfiltration will be determined by the Contracting Officer.

SECTION 02725

SANITARY SEWER APPURTENANCES

1. GENERAL: The Publications listed below form a part of this specification to the extent referenced.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1983) Gray Iron Casting
ASTM A 123	(1984) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 536	(1984) Ductile Iron Castings
ASTM C 33	(1986) Concrete Aggregates
ASTM C 94	(1989b) Ready-Mixed Concrete
ASTM C 150	(1989) Portland Cement
ASTM C 260	(1986) Air-Entraining Admixtures for Concrete
ASTM C 478	(1988a) Precast Reinforced Concrete Manhole Sections

2. PRODUCTS

2.1 Frames and Covers:

Frames and Covers shall be cast iron or ductile. Cast-iron frames and covers shall be as indicated in all essentials of design or to FS RR-F-621, Type as suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds and shall conform to ASTM A 48, Class 20B. The letter "S", at least 2 inches high, shall be stamped or cast into all covers so as to be plainly visible. Ductile iron for frames and covers shall conform to ASTM A 536.

2.2 Manhole Steps:

Shall be 1/2 inch grade 60 steel with a plastic or rubber coating pressure molded to the steel. Plastic coating shall conform to copolymer polypropylene. Aluminum steps or rungs will not be permitted.